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Cost-consequence analysis of "washing without water" for nursing home residents: A cluster randomized trial☆

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ABSTRACT

Background: No-rinse disposable wash gloves are increasingly implemented in health care to replace traditional soap and water bed baths without proper evaluation of (cost) effectiveness.
Objectives: To compare bed baths for effects on skin integrity and resistance against bathing and costs.
Design: Cluster randomized trial.
Setting: Fifty six nursing home wards in the Netherlands.
Participants: Five hundred adult care-dependent residents and 275 nurses from nursing home wards.
Methods: The experimental condition 'washing without water' consists of a bed bath with disposable wash gloves made of non-woven waffled fibers, saturated with a no-rinse, quickly vaporizing skin cleaning and caring lotion. The control condition is a traditional bed bath using soap, water, washcloths and towels. Both conditions were continued for 6 weeks.
Outcome measures were prevalence of skin damage distinguished in two levels of severity: any skin abnormality/lesion and significant skin lesions. Additional outcomes: resistance during bed baths, costs.
Results: Any skin abnormalities/lesions over time decreased slightly in the experimental group, and increased slightly in the control group, resulting in 72.7% vs 77.6% of residents having any skin abnormalities/lesions after 6 weeks, respectively ($p = 0.04$). There were no differences in significant skin lesions or resistance after 6 weeks.
Mean costs for bed baths during 6 weeks per resident were estimated at €218.30 (95%CI 150.52–286.08) in the experimental group and €232.20 (95%CI: 203.80–260.60) in the control group (difference €13.90 (95%CI: −25.61–53.42).

☆ Trial registration: ClinicalTrials.gov ID [NCT01187732].

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Conclusion: Washing without water mildly protects from skin abnormalities/lesions, costs for preparing and performing bed baths do not differ from costs for traditional bed bathing. Thus, washing without water can be considered the more efficient alternative.

What is already known about the topic?

- Bed baths with disposable wash gloves or washcloths are increasingly introduced as an alternative to washing with water and soap.
- Bed baths with disposable wash cloths are claimed to cost less than traditional bed baths, increase patient satisfaction and improve professional ergonomic aspects.

What this paper adds

- Bed baths with disposable wash cloths and bed baths with water and soap have similar effects on significant skin lesions and mildly protect from any skin abnormality/lesion.
- Costs for preparing and performing bed baths did not differ between both bed baths.
- Bed baths with disposable wash cloths can be considered the more efficient alternative.

1. Introduction

Bathing serves body hygiene and skin integrity, which in turn is vital to the prevention of disease (Bulechek et al., 2013). Bathing assistance is a major task in nursing and the quality and efficiency of bathing can have a large impact on health and health care costs. Yet there are no guidelines for preserving skin integrity with optimal bathing regimens.

Traditional bed baths have been the standard in bathing of bedridden patients for a long time. Their relevance for body hygiene has gone without debate and they are acceptable for patients and care professionals. Yet, use of soap in combination with water and towel drying has been reported to raise skin pH, remove natural skin oil, lead to skin dryness and decrease resistance to microbial invasion (Gray et al., 2012; Grunewald et al., 1995; Korting and Braun-Falco, 1996). Furthermore, bed baths have been reported to be stressful and leading to resistance and agitation in patients, and as being labor-intensive and physically heavy for nurses' backs and shoulders (De Bree, 2007; Sloane et al., 2004; Zweerts, 2004).

In the past decade, bed baths with disposable wash gloves or washcloths were increasingly introduced as an alternative for the traditional bed bath. These materials can be used with all patients who need bathing assistance, especially when taking a shower or sitting in a bath tub is not possible. Several pros and cons of disposable wash gloves are mentioned. On the positive side, disposable wash products are –most often – made of a mix of soft fibers and contain ingredients such as skin friendly cleaning and caring lotions that could optimize hygiene and skin integrity (Gray et al., 2012). Bed baths with disposable wash gloves supposedly cost less than traditional bed baths, increase patient satisfaction and improve professional ergonomic aspects (De Bree, 2007; Enzlin, 2001; Zweerts, 2004). On the negative, none of these claims can be related to evidence from well-performed studies. Also, counter opinions critique bed baths with disposable wash gloves as being impersonal, coming with less subjective cleanliness for patients and as being promoted for reasons of cost saving only (Jansen, 2008; Zweerts, 2004).

Despite the lack of evidence and the controversy surrounding bed baths with disposable wash gloves, they are rapidly being implemented in healthcare (Vilans, 2009).

Therefore, the current study aims to compare the traditional bed bath with a bed bath with prepackaged disposable wash gloves on effects on skin integrity, resistance during bed baths and costs. We also evaluated satisfaction in residents and nurses in the experimental group.

2. Methods

2.1. Study design

A cluster randomized trial (WASHING WITHOUT WATER) was conducted between April 2011 and November 2012. Randomization was performed prior to baseline data collection and at the level of nursing home wards (Altman et al., 2001; Campbell et al., 2004). Residents within the same ward were considered to be a cluster (Fig. 1). To ensure that all bed baths were performed according to randomization, we removed the washbowls from the rooms of the residents who were included and stocked their rooms with disposable washcloths.

Bed bath regimens were continued for 6 weeks and delivered by nurses from the ward.

2.2. Setting and participants

We included 56 nursing home wards in 22 nursing homes in the Netherlands. All elderly, long stay residents at the wards, who received bathing assistance, were included in the study, as elderly residents are considered to be at high risk for skin damage because their skin is more permeable (Ersser et al., 2005). Both care dependent residents who were legally capable and residents who were legally incapable due to dementia, were included in the study as in practice, disposable wash gloves are being implemented in both groups.

Residents, who showered or bathed in a bath tub more than once a week, or who were too sick to participate, were excluded.

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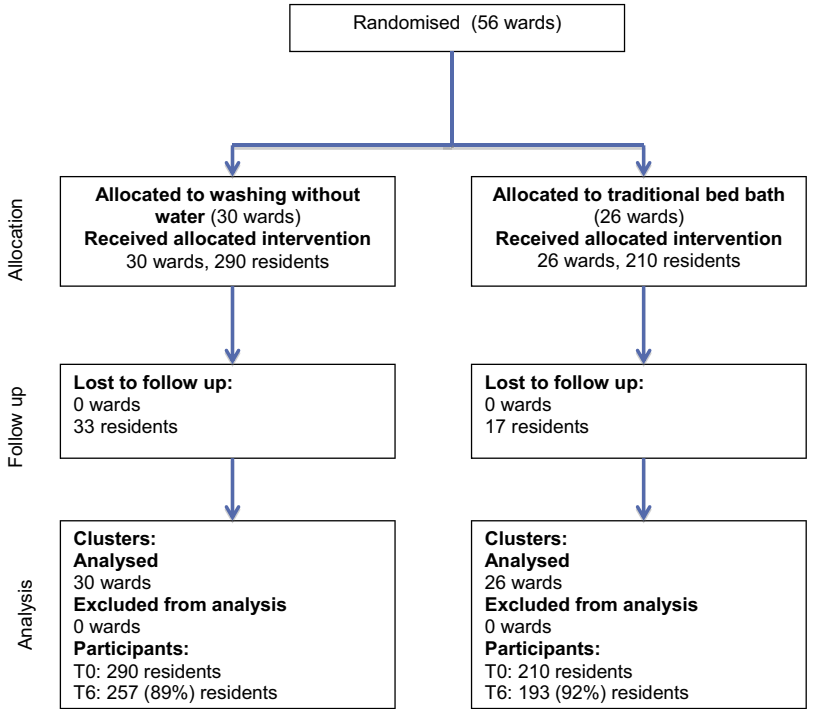

Fig. 1. Design of the study.

The ward manager checked which residents fulfilled the in- and exclusion criteria.

2.3. Randomization

The randomization of the wards was stratified for center and was performed by an independent statistician.

2.4. Intervention

A bed bath is defined as cleaning of the client's body for the purpose of cleanliness, performed by the nurse while the patient is lying in bed.

The experimental condition was bed baths with disposable washing gloves made of soft waffled non-woven fibers, impregnated with a no-rinse, quickly vaporizing skin cleaning and caring lotion, so named 'washing without water' (Table 1). A package of washing gloves contains eight disposable gloves to be used for one bed bath. The package was heated in a microwave. The choice for the disposable wash gloves used in this study was based on a pilot study on a hospital ward in a university medical center (Huisman-de Waal, 2009). In this pilot 10 different types of wash gloves were evaluated by nurses and patients. These wash gloves came out as one of three equally preferred products.

Table 1
Product information disposable wash gloves.

Weight: approx. 100 g/m^2
Measures: approx. 15 × 23 cm
Attachment: stitched
Ingredients lotion: aqua, glycerin, sodium benzoate, phenoxyethanol, potassium sorbate, disodium coco-glucoside citrate, sodium coco-glucoside tartrate, parfum, propylene glycol, butylene glycol, chamomilla recutita flower extract, glucose, bisabolol, citric acid, tetrasodium glutamate diacetate

The control condition was traditional daily bed baths executed by using tap water, washbowls, towels, wash gloves and soap. Washbowls were filled with tap water, and body parts were successively soaped, rinsed and dried by the nurse. Soap was usually supplied by the resident's family and consisted of all types of commercially available soap, foam, or gel.

3. Primary and additional outcomes

3.1. Skin integrity

The primary outcome for this study was prevalence of skin damage, defined as clinical symptoms of intertrigo, (contact) dermatitis, or candidiasis (Fredriksson and Pettersson, 1978; Gray et al., 2007; Kennedy and Lutz, 1996; LEVV et al., 2004).

We distinguished two levels of severity of skin damage.

Any skin abnormalities/lesions were considered present when at least one of the following symptoms were observed: bright red discoloration; erythema; white, green or yellow discoloration of the woundbed; atrophic and shiny skin; satellite lesions and kissing lesions, fissures, erosions or ulcerations (Fredriksson and Pettersson, 1978; Gray et al., 2007; Kennedy and Lutz, 1996; NVDVV et al., 2004). These symptoms should be present on the buttocks or one of the following 10 skin folds: eyes, neck, armpits,

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elbows, sub-mammary region, umbilicus, abdomen, groins, anal cleft, and between toes.

Significant skin lesions were considered present if the skin was not intact on the buttocks or one of the following four skin folds: sub-mammary region, abdomen, groins, and anal cleft.

3.2. Resistance

Resistance and agitation during bed baths was observed by research nurses and considered present if a resident showed one or more of the following behaviors (Sloane et al., 2004): wards the nurse off with hands, tries to avoid the nurse's touch, is restless, turns away, or struggles with the nurse, or protests verbally, for example by screaming or cursing.

3.3. Costs

Cost outcomes were costs for materials, and nurses' time investment for both bed bath regimens (Hakkaart-van Roijen et al., 2010).

Bed bath and skin care associated costs were calculated from associated staff time and materials used. All products used in the bathing procedure were recorded: liquid and bar soaps, lotions, protective ointments and creams, number of used wash cloths (both traditional and disposable), towels, laundry costs, number of washing bowls as an estimate for amount of water used, cost for cleaning washbowls, wound cleansers and wound dressings if applicable. Preparation for bed baths and performance of bed baths was timed with a stopwatch. Preparation included gathering of all materials. Performance of bed baths was timed from start of the bath (that is when the glove was first applied to the skin) until completion. If interruptions in bed baths occurred, timing was stopped and resumed when the bed bath continued.

3.4. Resident and nurse satisfaction with washing without water

Resident satisfaction was measured in the experimental group with a questionnaire with the following items: perceived discomfort during bathing, pain during bathing, perceived cleanliness during and after bathing, overall satisfaction (Huisman-de Waal, 2009). Additionally, residents or their legal representatives were asked whether they thought bed baths with a no-rinse disposable wash glove could replace bed baths with water and soap permanently.

Nurse satisfaction and *perceived work load* in the experimental group was measured with a questionnaire with the items ease of use, perceived resident comfort, perceived cleanliness of resident, perceived workload and overall satisfaction (Huisman-de Waal, 2009). Additionally, nurses were asked whether they thought bed baths with no-rinse disposable wash gloves could replace bed baths with water and soap permanently and whether they thought water and soap bed baths should remain available.

4. Data collection

All data were collected by research nurses who were trained in skin assessment and not involved in care delivery.

Baseline characteristics of the resident, that is age, gender, BMI, cognitive state, and skin status at study entry, were collected at the start of the study.

4.1. Skin integrity

Skin assessments were performed during 7 weekly visits (baseline and six follow-up visits).

4.2. Costs

Use of bathing materials and materials for skin damage care were established through observations in all bed baths in both experimental and control groups, using standardized case record forms. Bathing time was observed once per resident.

4.3. Resident and nurse satisfaction

Questionnaires were completed at the end of the 6-week study period by the residents or their legal representatives, and by the nurses in the experimental group.

4.4. Sample size

The original sample size of this study (288 residents per group) was calculated on the primary outcome: skin damage at the end of the 6-week intervention assuming a difference of 25% vs 15% (control vs experimental), alpha = .05, power = .80, ward size of 16, and ICC = .01. During the study we recalculated the sample size as we decided to perform a 3-level analysis using the baseline measurement and all follow-up assessments. This analysis is more accurate and efficient and enables a smaller sample size for the same level of power. Based on conservative assumptions (only baseline and follow-up at 6 weeks used in the analysis, small correlation between measurements at ward level, that is 0.3 and moderate correlation between measurements at resident level, that is 0.5, at most 20 residents per ward, a ward-ICC = 0.01, sample size unadjusted for clustering and repeated measurements of 250 per group) at most a sample size of 465 residents in total is needed (Teerenstra et al., 2012).

5. Statistical analyses

The effect of the two bathing regimens on any skin abnormalities/lesions and significant skin lesions was evaluated on an intention to treat basis using a 3-level logistic model for repeated measurements for the effect of group (experimental vs control) on prevalence of skin damage in time. Random effects for wards were included to account for clustering of residents within wards and random effects for residents were included to account for repeated measurements. Time trends and difference in

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time trends between groups were taken into account including the weeks and interaction with treatment as fixed effects in the model. These analyses were performed blinded, that is performed by a statistician not involved in data collection or building the databases; randomization was broken only after analyses were completed.

The ICC was calculated as the ratio of between ward variance and the total variance, the latter being the sum of the variance at ward level, at resident level and $\pi^2/3$ (for the binary measurement level).

Occurrence of resistance during bed baths and satisfaction with washing without water in residents and nurses from the experimental group were analyzed using descriptive statistics.

Analyses were performed using IBM SPSS Statistics version 20.

6. Cost analysis

To assess costs in both groups, we observed relevant volumes of care (time and materials) prospectively. In the cost analysis we used real cost prices for the time of nurses and the use of materials for the bed baths in both the experimental group (disposable wash gloves, use of the microwave) and the control group (soap, wash gloves, towels, warm water) (Hakkaart-van Roijen et al., 2010). We used real cost prices for skin and wound care products used. Cost analysis was performed at resident level. We calculated a mean for materials and time used per resident over the weeks 1–6 (excluding baseline). These means were multiplied with the aforementioned costs. The costs were compared between the groups using a linear mixed model analysis, which accounted for clustering of residents within wards.

7. Ethical considerations

This study was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki, 2013) for experiments involving humans.

The Medical Research Ethics Committee (MREC) of district Arnhem-Nijmegen assessed and approved of the study (2010/262; ABR nr NL32671.091.11).

Written informed consent was obtained from residents or their legal representatives.

8. Results

8.1. Resident characteristics

We included 500 residents in the study, 290 in the experimental group and 210 in the control group. The mean age of residents was 82.4 years (sd 8.3), and 71% ($n = 355$) were female.

Almost two-thirds (61.6%) of the residents were mentally incapable due to dementia (Table 2). No Suspected Unexpected Serious Adverse Reactions occurred during the trial.

Table 2
Characteristics of included residents.

	Washing without water ($n = 290$)	Traditional bathing ($n = 210$)
Age (mean (sd))	81.8 (8.7)	83.3 (7.5)
Female (n (%))	205 (70.7%)	150 (71.4%)
BMI (mean (sd))	25.4 (5.4)	25.4 (6.0)
Mentally incapable (n (%))	192 (66.2%)	116 (55.2%)

8.2. Any skin abnormalities/lesions

Prevalence of any skin abnormality/lesion was observed in residents at seven points in time (Table 3). There is a slight decrease in any skin abnormalities/lesions over time in the experimental group, and a slight increase in the control group, resulting in 72.7% and 77.6% of any skin abnormalities/lesions after 6 weeks, respectively. The treatment by time interaction was statistically significant ($p = 0.040$). This implies that the evolutions in skin lesion occurrence over time were different for the two groups, in favor of the intervention group. The ICC of this outcome is $1.11/(1.11 + 2.04 + \pi^2/3) = 0.17$. The correlation between measurements at resident level was $(2.04/(2.04 + \pi^2/3) = 0.38$.

8.3. Significant skin lesions

The percentage of significant skin lesions remains equal over time in the experimental group, and shows a slight decrease in the control group, resulting in 36% and 38% of significant skin lesions after 6 weeks, respectively (Table 3). The treatment by time interaction was not statistically significant ($p = 0.820$). The ICC of this outcome is $0.40/(0.40 + 1.87 + \pi^2/3) = 0.07$. The correlation

Table 3
Any skin abnormalities/lesions, significant skin lesions and resistance (in % of residents) in the 2 study conditions over time ($n = 500$).

	Washing without water	Traditional bed bathing
Any skin abnormalities/lesions		
Baseline	75.8	71.5
After 1 week	72.7	72.0
After 2 weeks	78.1	73.5
After 3 weeks	72.3	72.9
After 4 weeks	73.1	71.6
After 5 weeks	74.3	75.1
After 6 weeks	72.7	77.6
Significant skin lesions		
Baseline	37.7	41.2
After 1 week	34.2	39.5
After 2 weeks	39.8	39.7
After 3 weeks	42.8	41.2
After 4 weeks	41.3	38.6
After 5 weeks	37.4	39.9
After 6 weeks	36.0	38.0
Resistance		
Baseline	11.9	9.3
After 1 week	11.0	9.6
After 2 weeks	11.9	10.8
After 3 weeks	9.6	12.1
After 4 weeks	9.6	8.9
After 5 weeks	14.5	7.5
After 6 weeks	12.4	9.4

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between measurements at resident level was (1.87/(1.87 + π^2/3) = 0.36.

8.4. Resistance

At all but one of the moments resistance was higher in the experimental group, than in the control group, resulting in 12.4% and 9.4% of resistance after 6 weeks, respectively (Table 3). The treatment by time interaction was not statistically significant (p = 0.713).

9. Resident and nurse satisfaction about use of washing without water

9.1. Residents

Ninety-eight of the 290 residents in the experimental group resided on a ward for somatic care. Fifty-five (56%) of these residents completed the questionnaire and gave washing without water a grade of 7.1 out of 10 (sd 2.0). Residents indicated washing without water was effective in cleaning the skin (94% sufficient or good), and they felt refreshed afterwards (83% sufficient or good). The scent of the product was neutral or pleasant according to 42% and 50% respectively. Fifteen percent indicated that their skin felt more moist after washing without water. 61% (n = 31) of the residents indicated they would permanently trade water and soap bed baths for washing without water (Table 4).

One-hundred-and-two (53%) of the legal representatives of the 192 residents in the experimental group who resided on a ward for psychogeriatric care completed the questionnaire. Almost all of them indicated that they were not present during the bed baths and therefore could not judge the effect it had on the resident. Therefore it is impossible to analyze the satisfaction of the legally incapable residents.

9.2. Nurses

Nurses were mainly positive about washing without water and graded this with a 7.5 out of 10 (sd 1.2). Workload for the nurses was graded with a 1.7 out of 10 (sd 1.9). Sixty-one percent would trade standard care for bed baths from water and soap to washing without water. However, 74% feels that washing with water and soap should remain an option for residents.

The quality and structure of the product were evaluated positively. The extent to which nurses think residents were clean, fresh and satisfied with the product was estimated to be sufficient to good. Fifteen percent of the nurses indicated that the resident's skin felt more moist after washing without water (Table 4).

Table 4
Residents' and nurses' (n = 55) evaluations of washing without water.

	Residents (n = 55)				Nurses (n = 275)			
Overall satisfaction[a] (mean (sd))	7.1 (2.0)				7.5 (1.2)			
Comfort during bed bath[a] (mean (sd))	6.6 (2.6)				NA			
Burden during bed bath[a] (mean (sd))	2.4 (2.3)				NA			
Pain during bed bath[a] (median (IQR))[c]	0 (0-0)				NA			
Perceived work load[b] (median) IQR	NA				1 (0-3)			
	Insufficient	**Moderate**	**Sufficient**	**Good**	**Insufficient**	**Moderate**	**Sufficient**	**Good**
Effective skin cleaning (%)	1	5	52	42	1	7	60	33
Refreshed afterwards (%)	7	10	31	52	2	10	59	29
Quality of disposable washcloths (%)	NA	NA	NA	NA	0	3	29	68
Resident appreciation (%)	NA	NA	NA	NA	1	10	63	26
	Unpleasant	**Neutral**	**Pleasant**		**Unpleasant**	**Neutral**	**Pleasant**	
Scent of disposable washcloths (%)	8	42	50		NA	NA	NA	
	Clean, not different	**More moist**	**More dry/tight**	**More greasy**	**Clean, not different**	**More moist**	**More dry/tight**	**More greasy**
Afterwards, skin feels (%)	77	15	5	3	79	15	2	4
Washing without water can permanently replace bed bath with water and soap (%)	61				74			
Water and soap bed baths should remain available	NA				29			

NA: not asked
[a] On scale of 0–10: 0 is the worst score possible and 10 is the best score possible
[b] On scale of 0–10: 0 was no workload and 10 was the highest workload possible
[c] Median reported because of skewedness

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9.3. Cost-effectiveness

The mean costs for bed baths during 6 weeks is estimated at €220.03 in the experimental group and €243.35 in the control group. After linear mixed model analysis these mean costs were estimated at €218.30 (95%CI: 150.52–286.08) per resident in the intervention group and €232.20 (95%CI: 203.80–260.60) in the control group (Table 5). The difference in cost of bed baths was not statistically significant (€13.90 (95%CI: −25.61–53.42)). Bootstrapping to get a more precise estimate of costs did not change the results.

10. Discussion

This is the first randomized controlled trial into the effect of washing without water on skin integrity and costs. We showed that washing without water is a slightly more efficient intervention compared to washing with water and soap. The experimental condition does not differ from traditional bathing with respect to significant skin lesions, yet slightly protects from any skin damage. While it comes with no significant cost savings in nursing home residents, both residents and nurses are mainly positive about washing without water and residents in the experimental group did not show more resistance during bed baths than residents in the control group.

We found a much higher percentage of skin damage than we anticipated based on literature (Gray et al., 2012; Halfens et al., 2011). Defining skin damage as any discoloration or lesion to the skin at any skin fold, we found that over 70% of the residents had such lesions. As not all symptoms included in this broad definition of skin damage are considered clinically relevant, we also defined 'significant skin lesions', for which we still found a percentage of over 34% in both the control group and the experimental group. However, there were no differences between both groups. Thus, washing without water might prevent skin damage but that effect can only be seen in the analysis of any skin abnormalities/lesions, including the clinically non-relevant discolorations. To be certain about this effect longer follow-up is necessary, as sensitization to the ingredients in the wash cloths may build up over time.

Our study was performed in nursing homes and included both residents with somatic problems and residents with psychogeriatric problems. As the main outcome was skin lesions we assume our results are generalizable to other settings and resident groups. We certainly expect that residents with less vulnerable skin than nursing home residents will be able to tolerate washing without water.

10.1. Strengths and limitations

We believe our study has methodological strengths because of the randomized design, blinded analyses, and use of independent observers.

This study also has several limitations. First, we were not able to perform a double blinded trial. Both nurses and residents were aware of the way bed baths are being performed. Moreover, our research nurses assessed skin

Table 5
Costs per bed bath regimen.

	Average use per bed bath	Average costs (€)	Average costs per bed bath (€)	Average costs in 6 weeks/42 days (€)	Average costs in 6x weeks/42 days (€) linear mixed model analysis (95%CI)
Washing without water ($n = 272$)					
Preparation time	1.75 min	0.37 per nurse per min	0.65	27.3	
Actual bed bath					
Bathing time (mean)	7.82 min				
Nurses per bed bath (mean)	1.23 nurses				
Sub total personell	*7.82 min × 1.23 nurses*	*0.37 per nurse per min*	*3.56*	*149.52*	
Sub total material			*1.03*	*43.26*	
Total cost (bed bath and preparation)			**5.24**	**220.03**	**218.30 (150.52–286.08)**
Traditional bed bath ($n = 206$)					
Preparation time	1.94 min	0.37 per nurse per min	0.72	30.24	
Actual bed bath					
Bathing time (mean)	9.43 min				
Nurses per bed bath (mean)	1.22 nurses				
Subtotal personell	*9.43 min × 1.22 nurses*	*0.37 per nurse per* min	*4.26*	*178.92*	
Subtotal material			*0.81*	*34.02*	
Total cost (bed bath and preparation)			**5.79**	**243.35**	**232.20 (203.80–260.60)**

Bold highlights total costs
Italic highlights subtotals

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damage during bed baths. We chose this approach because it decreased the burden for the resident, that is they did not have to undress a second time, and because the research nurses needed to observe resistance and agitation in residents. However, nurses and research nurses were not strongly opposed or in favor of the experimental intervention and we have no indication that assessment bias was present. Therefore we think we have chosen for a strong design with a high level of evidence.

Second, we found a high prevalence of skin damage. An explanation for this could be that we did not take into account whether or not skin had been exposed to pressure directly prior to observation. It was not feasible to ask residents to offload pressure points before observing the skin. As pressure and subsequent offloading results in reperfusion of tissue, which may appear as redness (NPUAP and EPUAP, 2009), we probably included some normal skin reactions as 'any skin abnormalities/lesions'. This could be particularly the case on the buttocks and may indicate that we have overestimated the prevalence of any skin abnormalities/lesions in this study. Nevertheless, when we excluded redness from the definition of skin lesions, prevalence remained high, indicating that skin damage is a highly prevalent problem in nursing homes.

Third, we chose to include residents who are legally capable and residents who are legally incapable due to dementia, as disposable wash gloves are being used in practice in both groups. Assessing satisfaction about bed bath regimens was a challenge in residents with dementia as these residents are not able to fill out a questionnaire. Also, their legal representatives were not present during bed baths and could therefore not serve as proxies. We chose to observe bed baths for the presence of agitation or resistance. Although this leaves the assessment of satisfaction open to interpretation, observing this in a similar manner in both the control and experimental group does allow us to compare between bed bath regimens. A further limitation is that we captured resident satisfaction with a view to the acceptability of washing without water, but we did not compare satisfaction with bating assistance in both groups. This implies we now know residents are mostly satisfied with washing without water, but we cannot know if their satisfaction differed from satisfaction with traditional bathing.

Fourth, there are many companies offering no-rinse disposable wash gloves. As the ingredients in these products may differ, this could cause different skin reactions. To rule out this effect, we standardized the product used in this study. We delivered the wash gloves to the nursing home wards in the experimental group and made sure no other disposable wash gloves were present at that ward during the study period. We were not able to do the same for soap in the control group. However, we do not believe this is a problem, as we wanted to make a comparison to usual care in which a diversity of soaps and other products is present, as the family buys these for residents. Nevertheless, when implementing washing without water it is important to consider the price and quality of the alternative products. Products with other ingredients may yield other effects on the skin, and come at different prices.

Finally, it could be considered surprising that we were unable to confirm previous studies showing positive results on costs (Knibbe and Knibbe, 2006). While we did take into account the number of minutes it took for nurses to prepare for bed baths, we did not take into account how long it took to clean up afterwards. It is reasonable to assume that cleaning up takes more time in the control group. Taking these costs into account could have resulted in larger cost savings in the experimental group making bed baths with wash gloves more convincingly cost effective.

11. Conclusion

Washing without water and traditional bed bathing have similar effects on *significant skin lesions*, yet washing without water mildly protects from *any* skin abnormality/lesion. As costs for preparing and performing bed baths were more or less similar for both bed baths we conclude that washing without water is favored to traditional bed bathing and generally the more efficient alternative.

Author's contributions

LS and TvA designed the study. LS, BvG and TvA participated in the acquisition, data management and analysis, drafting and preparing the manuscript for publication. EA, ST and CvdV contributed to the design of the study, data analysis and preparing the manuscript for publication. All authors approved the final version of the manuscript.

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